FRD Activities Report
August 2003

Research Programs

CBLAST-High

Preparations continued in August to use the BAT Probe on NOAA P-3 for the upcoming hurricane season. Two flights were conducted with the BAT Probe installed on the NOAA P-3 over the Gulf of Mexico. The first flight (Aug 19) focused on calibration maneuvers for the BAT probe system, including pitch up/downs, yaws, wind circles, a wind box, and speed runs (acceleration/deceleration). Figure 1 shows samples of the attack angle, sideslip angle, and dynamic pressure calculated from the raw pressure measurements during some of these maneuvers. Comparison between the data from the BAT probe and data collected by the nose radome on NOAA P-3, to this point, are favorable. Work continues on calculating flight level winds and

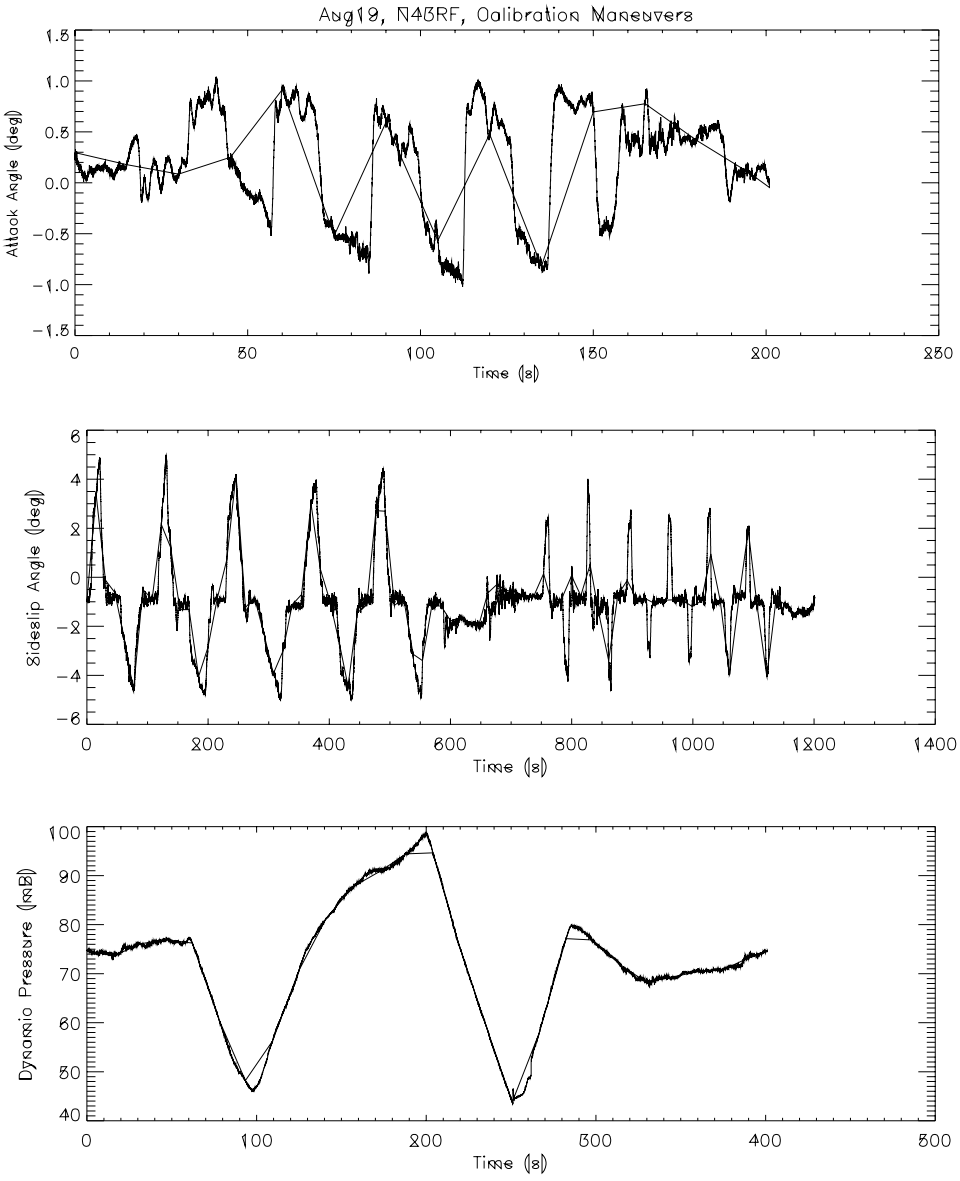

Figure 1. Attack angle, sideslip angle, and dynamic pressure calculated from the BAT probe on the NOAA P-3. Measurements made during the calibration flight on Aug 19.

temperature from these data.

The second flight (Aug 21) focused on practicing patterns and working through aircraft coordination that will be necessary for research flights. The basic flux pattern for the hurricane research flights (Figure 2) consists of a series of stepped descents, both in the along and crosswind direction. One of the aircraft (N42RF) will fly at an altitude of 7000 ft. The lower aircraft (N43RF), instrumented with the BAT probe, will fly an initial leg of 2500 ft. During this initial leg, N42 will drop a series of 5 GPS sondes and 3 AXBT in order to retrieve a temperature and wind profile through and just above the boundary layer. Upon completion of the roughly 20 nmi. leg, N43 will complete a 180 degree turn and descend to 1200 ft, nominally the top of the hurricane boundary layer. Each leg will take between 5 and 11 minutes to complete, depending whether it is flown with or against the wind. After each leg is complete the plane will turn and descend, with legs in addition to the 2500 ft. and 1200 ft., at 900, 600, 400 and finally 200 ft. Completion of the entire stepped descent pattern will take roughly one hour of flight time. During this time, it is crucial we remain in relatively rain-free air. This will, of course, require carefully picking a location between rain-bands, near enough to the eye of the hurricane for 60-80 kts surface winds, and a region that remains reasonably steady-state. (Jeff.French@noaa.gov)

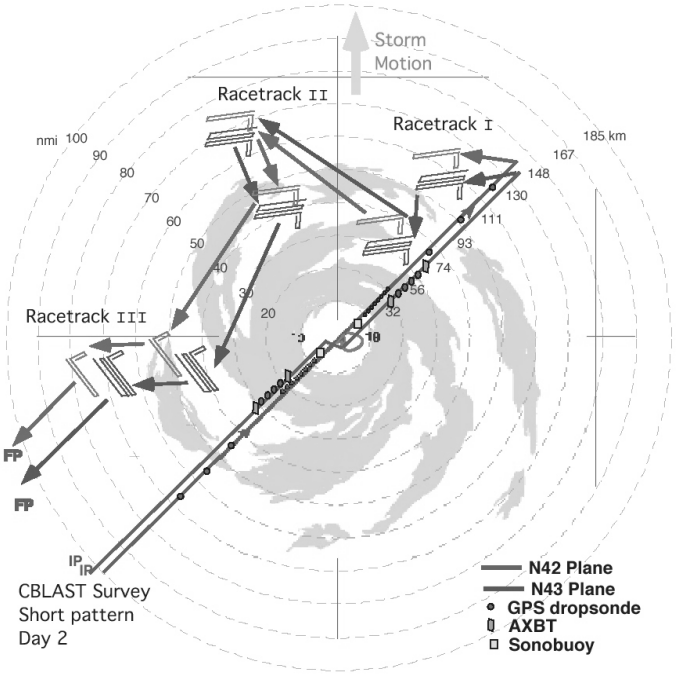

Figure 2. Flight pattern for conducting stepped descents during hurricane research flights. The first pass through the eye will allow us to survey the storm, stepped descents will then take place in regions between rain bands.

ET Probe

In late August, ATDD in Oak Ridge, TN sent the three ET probes in their possession back to FRD for testing and evaluation (Figure 3). They have had some trouble in getting them to work properly, whereas FRD has a fourth probe that has been working reliably for many months. It was immediately apparent that these three older probes were not configured the same as the fourth one. The current data acquisition software used with the probes is based on

Figure 3. All the ET probes are now back in FRD's shop. Tom Strong is holding one probe that is fully assembled. Two others have been split apart for testing.

the configuration of the fourth probe, and this explains many of the problems encountered at ATDD. FRD intends to reconfigure, calibrate, and test the three probes as quickly as possible, and then ship them back to Oak Ridge for possible deployment in a landfalling hurricane. (Richard.Eckman@noaa.gov, Tom Strong)

As reported last month, some effort has gone into the use of Bayesian Monte Carlo Markov Chain (MCMC) modeling to come up with more realistic confidence intervals for the turbulence statistics generated by both the ET probe and the INEEL sonic anemometer that is being used for comparisons. The attraction of this technique is that it has the potential to account for both autocorrelations and cross correlations in the data. Originally, attempts were made to use autoregressive (AR) models for the time series, but this did not lead to satisfactory results. The main problem is that a high-order AR model is necessary to provide a reasonable representation of Eulerian velocity time series, and these are too unwieldy for practical use. An alternate MCMC approach was developed based on the concept of an effective sample size. With 10 Hz sonic data, for example, there are 18,000 samples within a half-hour period. If all these samples are assumed to be independent, the resulting confidence intervals for the statistics will be very narrow. However, autocorrelation in the data reduces the effective sample size to something much less than 18,000. In one typical instance, the effective sample sizes for the horizontal velocity components and the temperature were down near 600, whereas for the vertical velocity it was in the 3,000-4,000 range. The MCMC approach based on effective sample size appears to provide reasonable results, and it runs quickly on even a modest desktop computer. (Richard.Eckman@noaa.gov)

JOINT URBAN 2003 (JUT)

Field operations for the Joint URBAN 2003 project were completed on Aug. 2, 2003, when laboratory analysis of the Programmable Integrating Gas Samplers (PIGS) for the final IOP was completed. Equipment was packed up and transported to Idaho Falls, arriving on the evening of August 5. An initial report was prepared to summarize FRD's efforts while in the field. Some of the more important points of that report follow below.

During the field deployment of JUT, sulfur hexafluoride (SF_6) tracer was disseminated a total of 69 times in 10 IOPs. Twenty-nine of these releases were continuous releases lasting 30 minutes, while 40 of these releases were instantaneous or puff releases. Releases from 5 IOPs were conducted from the so-called Botanical site near the north-east corner of Myriad Gardens on Robinson Street. Releases from three IOPs were conducted from the so-called Westin release site; one of these was actually in front of the Mid America Tower across the street from the Westin Hotel. Two more releases occurred in Park Ave. midway between Broadway and Robinson Streets.

The SF_6 continuous release rates ranged from 1.9 to 5.0 g s^{-1}. The total amount of material released in continuous releases was 155,650 g. The SF_6 puff releases ranged in size from 298 to 1,041 g. The total amount of material released as puffs was 24,490 g. Thus, the total amount of SF_6 released for all 10 IOPs was 180,140 g excluding amounts used for testing and troubleshooting. (Kirk.Clawson@noaa.gov)
Also during the JUT deployment, FRD operated 10 continuous SF_6 analyzers during each

intensive observation period (IOP), more than FRD has ever operated in the past. Nine of the analyzers were stationary during the releases and one was mobile. Because of the short-range nature of the urban experiment, the analyzers were tuned for their maximum dynamic range of 0 to 20,000 ppt SF_6. This made it difficult for some of the analyzers to make reliable measurements at very low concentrations (0 to 100 ppt). However, most of the plume observations peaked at several thousand ppt so lack of sensitivity at the low concentrations should not be a problem. All 10 continuous analyzers were operational for all 10 IOPs, making a total of 100 analyzer deployments. We are aware of 5 instances (5% of the 100 deployments) when an analyzer had mechanical problems and was out of operation for part of an IOP. In many previous experiments, a spare continuous analyzer was kept ready to replace a problem analyzer. For this experiment, all existing analyzers were deployed and no spares were available. We are pleased that the rate for successful deployments was this high.

The data analysis for the continuous SF_6 analyzers was begun in the field and has been continuing at our Idaho Falls office. Each data set from the continuous analyzers must be examined carefully to ensure that a good set of calibrations that meet QC criteria is available, all SF_6 peaks have been identified and no peaks caused by interfering chemicals or other sources are included. The identified peaks must then be extracted and instrument baseline subtracted. With 100 data sets to process, this represents a significant effort. We estimate that this process is currently about 50 percent complete. (Roger.Carter@noaa.gov)

The preliminary quality assurance/quality control information for the PIGS (stationary bag samplers) was as follows:

Field QC Blanks: The total number of blanks analyzed for the entire project was approximately 1800.
Field QC Controls: The total number of field controls analyzed for the entire project was also approximately 1800.
Field QC Duplicates: The number of field duplicates analyzed was approximately 1800 pairs, or 3600 samples.
Number of Field Samples: More than 18,000 samples were analyzed.
Total of Field Samples plus QC Samples: The number of field samples plus field QC samples was over 25,000. Field QC samples were 30 per cent of the total samples analyzed.

The following table summarizes the number of field samples that fell into various concentration ranges:

Concentration Range	Percentage of Samples
0-4 ppt	0.9%
4-10 ppt	66%
10-100 ppt	18%
100-1000 ppt	8%
1000-5000 ppt	5%
5000-50000 ppt	2%
> 50000 ppt	0.1%

The highest concentration was 106,000 ppt and was seen in IOP 1.

Using the 2.02 ppt standard as the basis for the calculation, the method limit of detection (MLOD) was determined to be 1 ppt while the method limit of quantitation (MLOQ) was determined to be 4 ppt. A determination had been made previous to field deployment to set the MLOQ no lower than 10 ppt due to possible carry-over issues with the valving system in the ATGASs. This concentration limit was determined based on analyzing a sample with at least a concentration of 50,000 ppt followed by a low level concentration sample and assuming such concentrations would be consistently analyzed during the project. Since the percentage of JUT sample concentrations in this range was so low, we feel that setting the lower limits of 1 and 4 ppt is warranted. The possibility of carry-over was so remote for so few samples that the samples within the 4-10 ppt concentration range (a majority of the data) are considered to be valid data points. However, a closer look at the influence of the higher concentration samples will be completed before the final data set is released. It should be noted that these results are the culmination of months of pre-planning to replace all of the sample bags and associated tubing, as well as the inclusion of a more intensive bag cleaning protocol. As the bags and tubing age, it is highly probable that the MLOD and MLOQ will rise slightly.

Although automation of the data process has been greatly streamlined, the final data set will not be released until every data point has been closely reviewed, which is an extremely labor-intensive process. All problems noted during the project will be reviewed and fixed. The data will need to be graphed to visualize possible issues that may not be apparent during data reviews. This review process will continue for several more weeks.(debbie@noaa.inel.gov)

We have also been conducting tests on the new "Super PIGS" samplers. The QC data from the field blanks and field controls show a number of problems which don't seem entirely consistent with what was observed on the regular samplers. We are investigating the effects of air temperature and handling procedures on the samplers to determine the cause of the problems. (Roger.Carter@noaa.gov, Debbie Lacroix, Randy Johnson)

Cooperative Research with INEEL

Emergency Operations Center (EOC)

The EOC was activated twice on August 13 for separate incidents. In the morning an accident with a waste barrel at RWMC triggered an activation. It lasted for a couple of hours. Later that same afternoon, a wildfire fire developed near NRF and triggered a second activation. This activation lasted until the early evening hours. Fortunately, one of the roads at the site acted as a fire break and limited the fire growth to a relatively narrow strip along the road. (Richard.Eckman@noaa.gov, Neil Hukari)

INEEL Support

A report produced by FRD on worst-case dispersion scenarios at INEEL is continuing to have ramifications on emergency preparedness at the site. The report used the MDIFF model together with nine years of Mesonet data to create probability density functions for the total integrated concentration (TIC) at various INEEL facilities. An estimate of “worst-case” dispersion events

was taken as the 95th percentiles from these pdfs. However, the report demonstrated that it is possible to generate more than one pdf from the same model output. For example, one pdf is created by including all the null TICs that occur when the plume totally misses a receptor, whereas another pdf is created by excluding these nulls. There is currently some debate on which pdf is the most appropriate for emergency planning. (Richard.Eckman@noaa.gov)

S.M. Stoller Corp. required further modifications to the MDIFF dispersion estimates that will go into the 2002 INEEL site environmental reports. Previously they had requested that MDIFF be run with individual unit releases from each of the major facilities at INEEL. In August they also wanted a composite MDIFF run using a unit release for the entire site. This was relatively simple to do once Stoller provided information on how the unit release should be distributed among the INEEL facilities. It was not necessary to rerun MDIFF to produce the composite estimates. (Richard.Eckman@noaa.gov)

Other Activities

NAERS

A preliminary agenda has been set for the second workshop of the Network of Airborne Environmental Research Scientists. The meeting will take place in Trento, IT, October 20-22. The workshop will focus on new and emerging technologies and how they may be applied to airborne research as well as updates to existing instrumentation. The workshop provides an opportunity for scientists from around the world to gather and discuss issues unique to the operations of research programs utilizing small aircraft. The NAERS group is truly one-of-a-kind in the realm of small aircraft research programs. For more information on NAERS and the upcoming workshop, visit the group's discussion page at http://groups.yahoo.com/group/naers (Jeff.French@noaa.gov)

Awards

The winners of the 2003 Department of Commerce Gold and Silver Medals were announced August 8. At the ceremony in Washington, D. C. on September 18, Tim Crawford will be given a Gold medal posthumously for Scientific/Engineering Achievement. Tim was Director of the ARL Field Research Division from January 1998 until his untimely death in August 2002.

Travel

Although the last Joint Urban 2003 test was completed on July 29, many of the participating personnel remained in Oklahoma City into the first week of August to complete sample analysis, equipment removal, and reloading of all gear deployed to OKC. Kirk Clawson, Neil Hukari, David George, Chris Biltoft, Shawn Eldredge, and Mark and Dianne Hoover left Oklahoma City on July 31. Camille Erwin arrived in Idaho on August 2; Debbie Lacroix returned August 4; Roger Carter, Shane Beard, Tom Strong, and Ryan Walker, with the trailers and vans containing the instruments and equipment arrived back at FRD on August 5.

Jeff French, August 17 - 23, to Tampa, Florida, for instrument calibration and flight tests in preparation for CBLAST-High Project

Jeff French, left August 31 for Tampa, Florida, to participate in hurricane research flights (CBLAST-High). He will return about Sept 7.